

Background

One of the major challenges facing the Department of Energy, is determining how it can best meet its obligation to disposition the spent nuclear fuel which remains as a legacy of the now shutdown Experimental Breeder Reactor-II (EBR-II) at the ANL-West site in Idaho.

The EBR-II is a liquid-sodium-cooled test reactor that operated for 30 years, primarily in support of the Department's Integral Fast Reactor (IFR) and other breeder reactor research programs. With the cancellation of the IFR program, the decision to shut down the EBR-II and some smaller support facilities was made in October 1994. The EBR-II spent nuclear fuel and blanket assemblies were removed from the reactor in December 1996, and are temporarily stored in Idaho. This is a metallic fuel with elemental sodium between the uranium fuel pins and the fuel cladding.

The Department is obligated under a settlement agreement with the State of Idaho (the Batt Agreement: resolution of *U.S. vs Governor Batt, Civil No. 91-0054-S-EJL*, reached in October 1995), to manage and prepare this spent fuel for ultimate disposal outside the state, e.g., in a geologic repository. The state of Idaho and others have pointed out that the fuel in this reactor presents a challenging waste management problem. The presence of the sodium makes the EBR-II spent fuel unique. Sodium metal is highly reactive; it burns in air and can explode when exposed to water. Because the sodium is partially absorbed by the uranium fuel elements, mechanical means will not be fully effective in removing it. Therefore, conservative assessments indicate this fuel will have to be treated to create a waste form acceptable for long-term disposal in a geologically-mined repository. Other DOE spent nuclear fuels may also require treatment prior to long-term disposal. Particular attention is being paid to DOE spent fuels in Idaho, since these, along with the EBR-II fuel, must be removed from that state by 2035. The intent is to dispose of these fuels geologically.

An electrometallurgical treatment technology developed at Argonne National Laboratory (ANL) may provide a solution to these treatment and disposal needs, by converting problem spent fuel into a durable metallic waste form and a ceramic waste form which binds all the plutonium in the fuel along with highly radioactive fission products. This treatment technology **is not a reprocessing technology**, and does not separate plutonium from the fuel. Moreover, rather than producing additional high-level waste streams, this technology results in a significant volume reduction in waste that must be placed in long-term storage, or sent to a geologic repository.



Researcher tests new electrometallurgical equipment at Argonne-West

Program Description

To evaluate this technology and decide how it should be applied, an electrometallurgical treatment technology demonstration program has been completed. There are two major activities integrated under this program: treatment demonstration and treatment R&D. Electrometallurgical treatment techniques were demonstrated at ANL-West on a small amount of EBR-II spent fuel (about 6.25 percent of the EBR-II spent fuel inventory). Electrometallurgical treatment R&D at ANL-East supported this demonstration by providing experimental data, modeling and analyses needed for full process integration and scale-up to production capacity, and to make any necessary improvements as technical challenges arise in demonstration operations. Both the demonstration and R&D activities concluded in FY 1999.

The EBR-II demonstration determined the capacity and reliability of high-throughput treatment, and evaluated the effectiveness of placing plutonium and fission products in the ceramic waste form. Experimental-data analyses and testing of waste forms at ANL-East supported the development of demonstration equipment and methods to produce metal and ceramic waste forms having superior consistency, durability and ease of fabrication. Additionally, to permit full characterization of the repository performance of electrometallurgical high-level waste forms, test methods and a performance model were developed, which are embodied in a qualification plan.

We will use this qualification plan, in cooperation with the Offices of Environmental Management and Civilian Radioactive Waste Management, to assess risks associated with achieving repository acceptance of electrometallurgical waste forms.

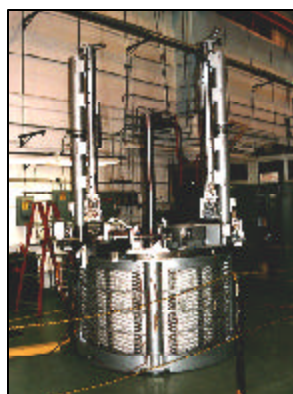
Any future application of this treatment technology in fiscal year 2001 and beyond will be encompassed in another Department program as appropriate.

Independent Program Evaluation

Activities under the electrometallurgical technology Program were reviewed by the National Academy of Science, which provided its findings and recommendations to the Department in periodic reports as well as independently evaluated the program results in a final report. The final report, released in April 2000, stated that the committee found "that ANL has met all of the criteria developed for judging the success of its electrometallurgical demonstration project." The committee also found "no technical barriers" to the use of electrometallurgical technology to process the remainder the remainder of the EBR-II fuel.

Record of Decision

The Department expects to reach a technology decision for the disposition of its sodium-bonded spent nuclear fuel in Fall 2000. All necessary measures will be taken to ensure this decision is environmentally sound, consistent with policy and law, and cost-effective. This decision will require environmental, as well as other impacts, such as nonproliferation and cost, be assessed and considered.



High-throughput Electrorefiner
at Argonne-West

FY 1999 Major Accomplishments:

Appropriated funding of \$30 million plus \$9.2 million of reprogrammed prior year balances were employed to accomplish the following:

- Maintained the FFTF in a safe and environmentally compliant condition pending a decision on its future use.
- Reached a decision to include both shutdown and restart of the FFTF in alternatives to be evaluated in a NEPA review of the Department's proposed action to manage its nuclear facility infrastructure to meet expanded civilian R&D missions.

The Department has prepared an Environmental Impact Statement (EIS) in which electrometallurgical treatment and several alternative technologies are evaluated and analyzed for their environmental and socio-economic impact. A draft EIS was released in July 1999, and was made available to the public, as well as other Federal Agencies, American Indian tribes and governments, state and local governments, and all interested parties, for review and comment. Public meetings on this draft document were held in which all members of the public, including the environmental community, were encouraged to participate. This is an open and fair process that provides meaningful opportunities for the public to obtain information and provide comment. The Department will carefully consider and address all comments in its final EIS.

Separate reports have assessed the cost and nonproliferation impacts of applying each of the technology alternatives being considered in the EIS to the disposition of sodium-bonded spent nuclear fuel. These, along with the EIS, National Academy of Science reports, and any other necessary information, will be factored into the decision-making process.

FY 2000 Planned Accomplishments:

- Reached a decision for the treatment and management of the Department's inventory of sodium-bonded spent nuclear fuel.
- If the decision is made to treat some or all of the Department's inventory of sodium-bonded spent nuclear fuel using electrometallurgical treatment technology, complete fuel Condition, containment facility maintenance and resume treatment activities

FY 2001 Planned Accomplishments:

- If the decision is made to treat some or all of the Department's inventory of sodium-bonded spent nuclear fuel using electrometallurgical treatment technology, 0.6 metric tons of heavy metal of fuel would be treated and long-term tests to characterize performance of reference waste forms would be conducted.

Program Budget Electrometallurgical Treatment Technology (in millions)			
	FY 1999 <u>Appropriation</u>	FY 2000 <u>Appropriation</u>	FY 2001 <u>Appropriation</u>
Electrometallurgical Treatment Activities	\$47.5	\$42.1	\$34.8
ANL-W Facilities Operations	<u>\$37.0</u>	<u>\$36.7</u>	<u>\$39.2</u>
TOTAL	\$84.5	\$78.8	\$74.0

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